THE NEMATODE GENUS *MAXVACHONIA* (OXYURATA: COSMOCERCIDAE) IN AUSTRALIAN REPTILES AND FROGS

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Summary

The genus *Maxvachonia* Chabaud & Brygoo, 1960, previously known only from reptiles in Madagascar, is now recorded in Australia and New Guinea. New species described are *M. chabaudi* from 7 species of skinks, 1 species of gecko, and 1 species of snake (? from food); *M. brygooi* from 5 species of agamid lizards; and *M. ewersi* from a frog, *Litoria nasuta*, from New Guinea. *M. flindersi* (Johnston & Mawson) [syn. *Aplectana flindersi* J. & M.], is recorded from 5 species of Australian frogs and one introduced species, *Bufo marinus*. The genus *Austrocerca* Inglis, 1968, is regarded as a synonym of *Maxvachonia*.

Introduction

Maxvachonia dimorpha Chabaud & Brygoo (1960, p. 129) was first described from *Chamaeleon pardalis*, and later also from *C. australe* (Chabaud, G. R. Caballero, & Brygoo 1964, p. 846), in both cases from a small island, Nossi-Bé, about 20 km from the mainland of Madagascar. It has since been recorded from one chameleon and two other species of lizards (*Zonosaurus maximus* and *Mabuia gravenhorstii*) on Madagascar itself. (G. Caballero 1968, p. 192.)

Although the genus was not recognised until recently, and does not appear to be common in any host species, it is surprisingly widespread. The seventeen species of Australian lizards from which *Maxvachonia* spp. are recorded in this paper belong to the families Scincidae, Agamidae, and Gekkonidae, and they come from a wide geographical range. One collection was made from the stomach of a snake, but as this also contained some semi-digested skinks, the snake may not be a true host record.

The genus is not confined to reptiles. *Austracerca* Inglis (1968, p. 164) appears to be a synonym of *Maxvachonia*. Inglis recorded *A. flindersi* (Johnston & Mawson) (syn. *Aplectana flindersi*) from three frog species in Western Australia. It has now been recognised from five more frog species from various parts of Australia, and from a toad, *Bufo marinus*, introduced into Queensland sugar cane fields in 1934. Another species is recorded from a frog from New Guinea.

The males and females of *Maxvachonia* spp. are very different in size, but the morphology of the anterior end is similar in the two sexes. Both males and females are easily distinguished from other cosmocercoid genera, the female by the great distance of the anus from the posterior end of the body, and by the shape of the eggs, and the male by the shape of the gubernaculum, which is very large and bears two prominent projections near its proximal end.

The differentiation of species within the genus is rather more difficult. The presence or absence of lateral alae on the anterior part of the body in the female appears to be a specific character. There is a wide variation in the body length of the female within a species, although fully adult specimens from the same host animal are usually about the same size. The ratio of the body length to that of the oesophagus varies considerably, possibly due at least in part to the degree of contraction of the body in different collections. The ratio of body to tail length in the adult is more constant, and may be of specific significance. The egg size is similar in all specimens available, but there is some variation in the shape of the projection on the egg shell and of the envelope which surrounds the egg in the vagina, and these appear to have specific value.

The male worms are rare compared with the female, so that it is even harder to assess the specific value of any character. The body length and that of the oesophagus are very similar among all the specimens examined. There is some variation in the lengths of spicules and gubernaculum but even these vary almost as much between two specimens from the same host animal (in the only case where two males were found in one host) as among all the males collected in Australia.

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On these slender criteria, three species have been distinguished from Australian reptiles, one (*M. flinderi*) from Australian frogs, and one from a New Guinea frog. The general body form is similar in all species, and agrees generally with the descriptions of Chabaud & Brygoo (1960) and Chabaud *et al* (1964) and of Inglis (1968). Some additional observations and distinguishing characters are noted under the species. Measurements are given in Tables I and II. Type specimens will be deposited in the South Australian Museum.

Maxvachonia chabaudi n.sp.

FIGS. 1–6

Hosts and localities: *Morethia lineoocellata* (Duméril & Bibron), type host; *Lerista bougainvillii* (Gray), *Ctenotus leae* (Boulenger), *Pseudonaja ? affinis* Günther, all from Eyre Peninsula, S. Aust.; *Ctenotus labillardieri* (Gray) from Pemberton, W. Aust.; *Hemiergis peronii* (Fitzinger) from Pemberton and Esperance, W. Aust.; *Sphenomorphus australis* (Gray) from Wilgarup, W. Aust.; *S. kosciuskoi* (Kinghorn) from the New England district, N.S.W.; *Egernia whitei* (Lacépède) from Penola, S. Aust.; *Phyllurus milii* (Bory) from Kangaroo I., S. Aust.

Most of these collections consist of female worms, adult and/or juvenile (i.e. with or without embryonated eggs). There are five males, two from *Ctenotus leae*, one from *Lerista lineoocellatus* and one in each of two *H. peronii*. In these last two there were no females, and as this species of *Maxvachonia* is separated from others by characters of the female, the inclusion of the males is arbitrary.

Alae are present in both sexes. There are three lips, the inner border of each projecting as a cuticular lamella. The mouth is triangular, or triradiate. Each lip is strengthened by a chitinous bar, the three bars meeting to form a triangle around the anterior end of the buccal cavity. The short triangular buccal capsule rests against the anterior end of the oesophagus. Three well-defined teeth project from the oesophageal lining into a depression in the anterior end of the oesophagus.

Female: Lateral alae extend from the level of the nerve ring to about the mid body. The posterior end of the body ends in a more or less distinct mucro, which is rugose. The vulva, a transverse slit, lies at about the level of the isthmus of the oesophagus. The two ovaries commence shortly in front of the anus, pass backwards nearly to the posterior end of the body where each enters a short oviduct, leading to a slightly wider, sometimes almost spherical, thicker-walled section (? seminal receptacle) from which the uterus leads forward. The two uteri pass forward side by side, uniting to form the vagina at about a quarter of the body length from the anterior end, or a little in front of this.

Eggs in the anterior parts of the uteri each contain a coiled larva. The eggs are roughly spherical, slightly longer in the axis through the knob on the shell. In the vagina, where they are less crowded, they are seen to be surrounded by a spongy or reticulate material which forms a loose envelope attached to the shell by, or at, the apical knob, more or less open at the opposite pole (Fig. 5) and often trailing two ribbon-like pieces from the open end. This envelope was noted in the original description of *Maxvachonia dimorpha*.

Male: The lateral alae extend for most of the body length, from the level of mid-oesophagus to shortly in front of the anus. The posterior end of the body is strongly curved ventrally. The gubernaculum is large and heavily built, with a pair of lateral processes near the proximal end. The spicules are slender, well chitinised, and blunt-tipped. The cloacal opening is on an elevation of the body wall. The thirteen pairs of caudal papillae are arranged as shown in Fig. 6.

The species is distinguished from *M. dimorpha* chiefly because of the presence of lateral alae in the female. The females are all shorter, and the males about the same size, as those of *M. dimorpha* but the spicules and gubernaculum are larger.

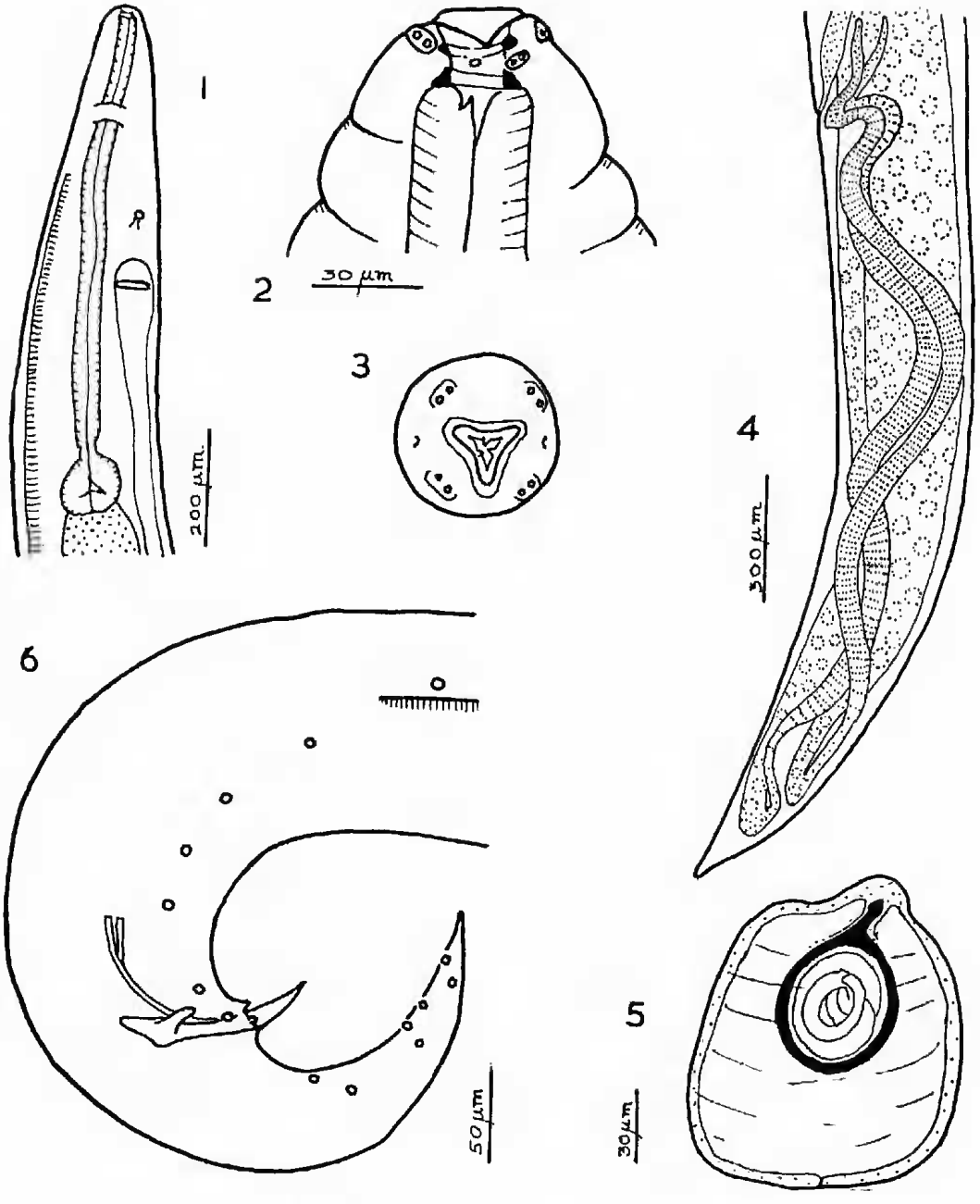
Maxvachonia brygooi n.sp.

FIGS. 7–10

Hosts and localities: *Amphibolurus decresii* (Duméril & Bibron), type host; *A. maculatus* (Gray), both from Eyre Peninsula, S. Aust.; *A. inermis* (De Vis) from Yuendunu, Northern Territory; *A. muricatus* (Shaw) and *A. barbatus* (Cuvier) from N.S.W.

Only females have been taken from these agamid lizards. All of them, however, differ from those from skinks in the absence of lateral alae. In other respects they are very similar.

Although this distinction is slight, it is constant. Notwithstanding the fact that agamids and skinks occurred in the same locality in Hincks National Park on Eyre Peninsula, *Maxvachonia* spp. from the agamids were always



Figs. 1–6. *Maxvachonia chabaudi.* Fig. 1.—Oesophageal region. Figs. 2, 3.—Lateral and *en face* views of head, to same scale. Fig. 4.—Posterior end of female. Fig. 5.—Egg. Fig. 6.—Posterior end of male.

without alae, while those from the skinks had alae. In view of this it is thought safer to regard the two groups as separate species, at least until more specimens, especially males, are found.

Maxvachonia sp.

Host and locality: *Morethia taeniopleura*, Mornington I., Gulf of Carpentaria.

Only one female was collected from this host; it is very similar to females of *M. chabaudi* but the ratios of oesophagus and tail to the body length differ markedly (Table 1).

Maxvachonia flindersi (Johnson & Mawson)

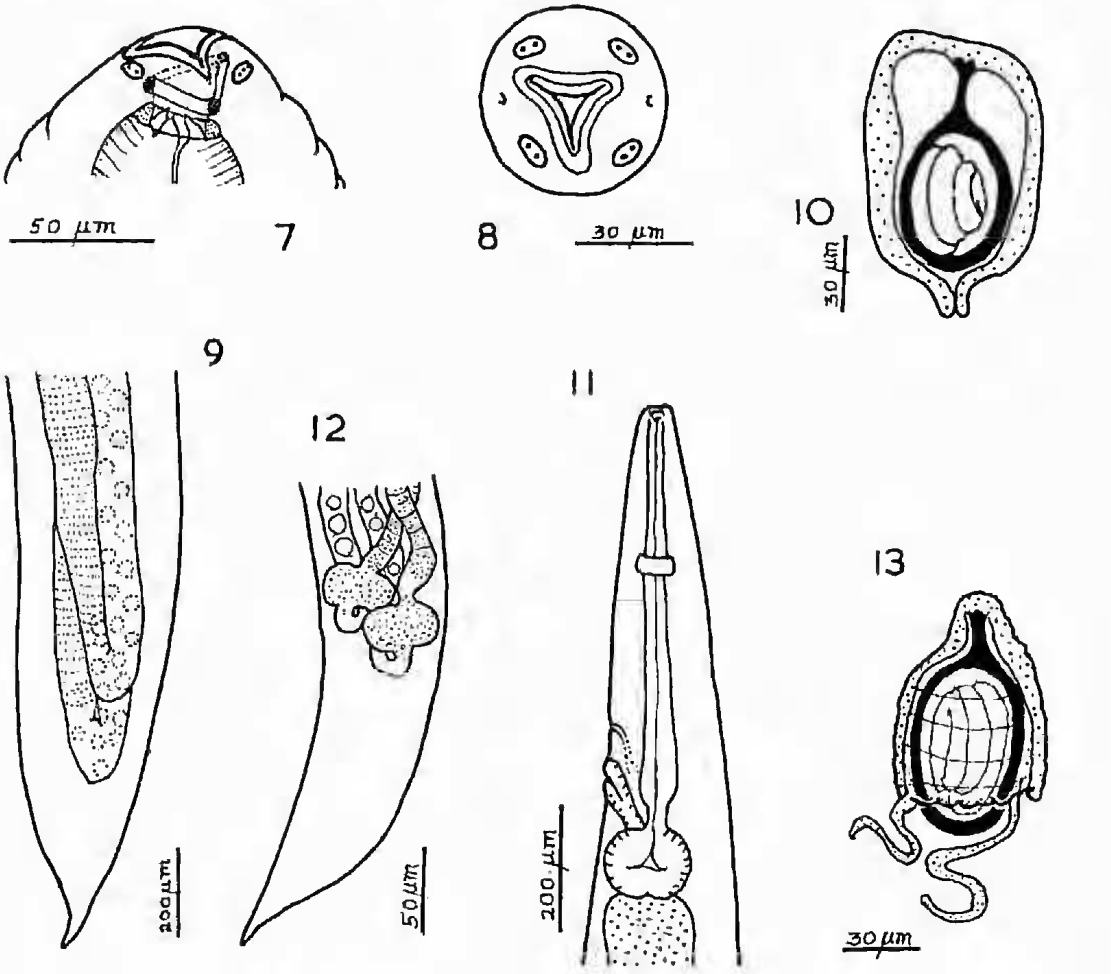
FIGS. 11–13

Aplectana flindersi Johnston & Mawson, 1941: 148, from *Litoria ewingi* (syn. *Hyla jervisensis*) from Kangaroo I., S. Aust.

Austrocerca flindersi (Johnston & Mawson) Inglis, 1968: 165, from *Litoria coeloryncha, Heleioporus barycragus* and *H. psammophilus*, from W. Aust.

Host and localities: *Bufo marinus* Linn. from Queensland; *Limnodynastes dorsalis* (Gray) from Adelaide, S. Aust.; *Heleioporus inornatus* Lee & Main, *Litoria moorei* Copland, *L. adelaidensis* (Gray) from near Perth, W. Aust.; *L. caerulea* (White) from Alice Springs, N.T.

All the hosts listed above are new records for *M. flindersi*. The new male specimens agree closely with the earlier descriptions, both in size and appearance, but the females are distinctly larger, even those from related hosts in Western Australia. Through the courtesy of



Figs. 7–10. *Maxvachonia brygooi*. Figs. 7, 8.—Lateral and *en face* views of head. Fig. 9.—Posterior end of female. Fig. 10.—Egg.

Figs. 11–13. *M. flindersi*. Fig. 11.—Anterior end of female. Fig. 12.—Posterior end of female. Fig. 13.—Egg.

Dr. W. G. Inglis and of the Western Australian Museum it has been possible to compare all the known specimens, and no significant difference other than size was observed. The details of the female reproductive system have now been studied, and these agree generally with the form in other species of the genus. The ovaries begin shortly in front of the anus. The eggs in the uteri are enclosed in the characteristic outer envelope, which in some specimens is very dark. The envelope is in the form of a bell attached to the knob of the shell at its apex and open at the other end; from the open end come two long ribbons of material similar to that of the envelope. In one case an egg lying just outside the body of the female was still attached by one of these ribbons, which passed into the vulva.

Maxvachonia flindersi differs from *M. dimorpha* in the presence of well developed lateral alae in the female, and from both *M. dimorpha* and *M. ewingi* (see below) in the shape of the seminal receptacle. The size of the spicules and gubernaculum vary greatly in the few male specimens known, but the gubernaculum is always distinctly longer than the spicules.

Maxvachonia ewersi n.sp.

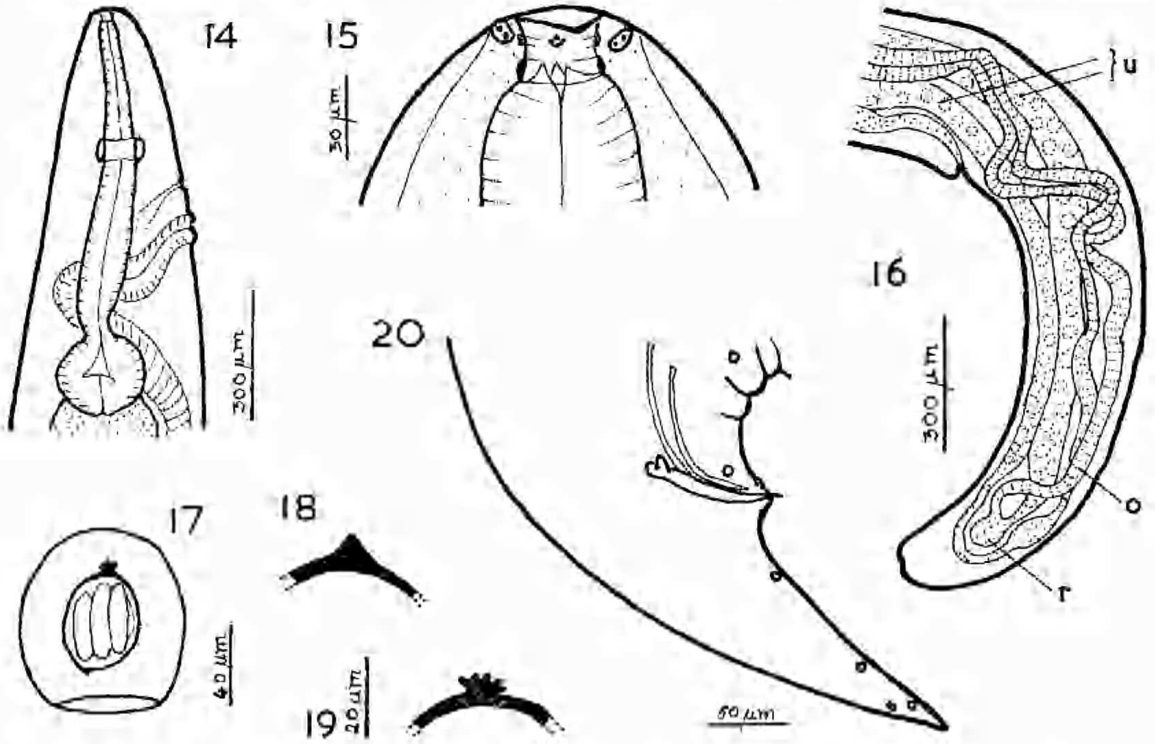
FIGS. 14–20

Host and locality: *Litoria nasuta* (Gray) from Brown River, New Guinea.

The material consists of three female and one male worms. The general body form is very similar to that of *M. flindersi* and other species of the genus; measurements are given in Table 2.

The characters distinguishing this species from *M. flindersi* are the following:

1. The oesophageal teeth are much smaller (Fig. 15).
2. The spicules are distinctly longer than the gubernaculum.
3. There are only two pairs of preanal papillae in the male. The other caudal papillae are arranged as in *M. flindersi*.
4. In the female the posterior end of the body appears rounded, because the extreme tip is slightly withdrawn forming a dimple.
5. The arrangement of the reproductive organs in the female is slightly different. The ovaries start much further forward at about



Figs. 14–20. *Maxvachonia ewersi*. Fig. 14.—Oesophageal region, female. Fig. 15.—Lateral view of head. Fig. 16.—Posterior end of female. Fig. 17.—Egg. Figs. 18, 19.—Two views of apical extension of egg shell, to same scale. Fig. 20.—Posterior end of male. o, ovary; r, seminal receptacle; u, uterus.

two-thirds the body length from the head, and the seminal receptacle is not so much wider than the uterus and ovejector.

6. The shape and size of the eggs are different. The knob on the shell is shorter, and appears conical on one axis, but broad and grooved on an axis at right angles to this; the egg itself is slightly flattened in this latter view. The coils of the larva lie in the plane of the wider diameter. The envelope surrounding the egg is thinner than in other species, although it is dark in colour, and forms a bell, attached at knob end of the egg, similar to those of *M. flindersi*, but more definite in shape (in these specimens at least). In eggs furthest from the vulva (but in the vagina) the mouth of the bell is open, but in those nearest to the vulva it is closed.

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I am also indebted to officers of the South Australian Museum, Mr. M. Tyler, Hon. Associate in Herpetology, and Dr. T. Houston, Curator of Amphibia and Reptiles, for information on the nomenclature of the hosts.

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TABLE 1

Measurements of Maxvachonia *spp. from Australian reptiles; unless otherwise stated, measurements are given in μm.*

Species	*M. chabaudi*						*M.* sp.	*M. brygoo*		
host group	Skinks				Geckos	Snake	Skink	Dragons		
locality	Type host, S. Aust.	Others, S. Aust.	W. Aust.	N.S.W.	S. Aust.	S. Aust.	Qld. Mornington I.	S. Aust.	N.S.W.	N.T.
♂ Length (mm)	2.5	2.3, 2.5	2.4, 2.7	—	—	—	—	—	—	—
Oesophagus	380	520, 500	450, 370							
L/Oes. length	6.6	5.1, 5.0	5.3, 7.3							
A—nr	145	330, 300	165, —							
—ex.p.	330	200, 200	300, 310							
Spicules	120	120, 125	120, 130							
Gubernaculum	130	160, 160	135, 150							
♀ Length (mm)	7.3–8.7	6.0–15.5	9.6–10.3	11.7–13.7	7.5–14.9	7.2–9.6	8.5	9.3–10.8	8.8–12.9	8, 11.9
Oesophagus	720–800	570-980	800–880	890–950	570–920	720–890	500	800–900	620–770	750, 1080
L/oesoph. length	10.2–11.0	9.3–16.8	11.6–12.5	13.1–14.4	12.6–17.9	10–11.8	17.0	10.3–13	13.5–16.7	10.6, 11.0
A—nr	150–180	160–280	220–270	220–270	–320–	240–300	160	250–270	210–220	—, 250
—ex.p.	270–370	300–630	410–500	450–560	400–600	400–450	240	370–	350–420	—, 550
—vulva	380–500	380–800	520–600	600–700	500–600	530–650	350	490–	500–	—, 780
Tail (mm)	1.9–2.6	1.5–4.2	2.0–2.3	2.9–3.3	1.5–3.8	2.1–2.9	0.92	2.3–2.9	2.1–3.1	1.6, 3.1
L/Tail length	3.3–4.2	3.6–4.2	4.5–5.1	3.9–4.5	4.1–4.2	3.7–4.1	9.2	3.5–4.9	3.9–4.2	5.0, 3.8

TABLE 2

Measurements of Maxvachonia *spp. from Australian frogs: unless otherwise indicated, measurements are given in μm.*

Species	*M. flindersi*						*M. ewersi*
locality	S. Aust.	W. Aust.	W. Aust	W. Aust.	N.T.	Qld. (introduced)	N.G.
host	*Limnodynastes dorsalis*	*Heleioporus inornatus*	*Litoria moorei*	*L. adelaidensis*	*L. coerulea*	*Bufo marinus*	*Litoria nasuta*
♂ Length (mm)	—	—	—	2.2	2.35	—	2.4
Oesophagus				370	380		350
L/oes. length				5.9	6.2		6.9
A—nr				190	170		
—ex.p.				230	290		
Spicule				100	150		120
Gubernaculum				120	180		100
♀ Length (mm)	8.9–11.1	6.7–9.8	8.1–9.0	11.2–11.3	6.2–9.0	8.8–11.1	11.0–16.3
Oesophagus	680–900	750–870	710–820	720–780	700–750	680–800	700–900
L/oesoph.	9.9–15	8.9–12.1	10.4–11.4	14.5–15.7	8–12.1	11.3–13.9	14.7–17.2
A—nr	230–270	230–270	250–290	220–290	200–210	200–290	250–330
—ex.p.	430–550	430–550	450–540	450–500	350–420	400–510	320–420
—vulva	570–720	540–690	600–690	580–640	470–550	530–630	450–540
Tail (mm)	1.8–2.5	1.3–2.2	1.7–1.8	2.5–2.8	1.5–2.2	1.6–2.3	2.3–3.3
L/tail	4.5–5.5	4.5–5.1	4.9–5.0	4.0–4.5	4.1–4.7	4.8–5.9	4.7–4.8